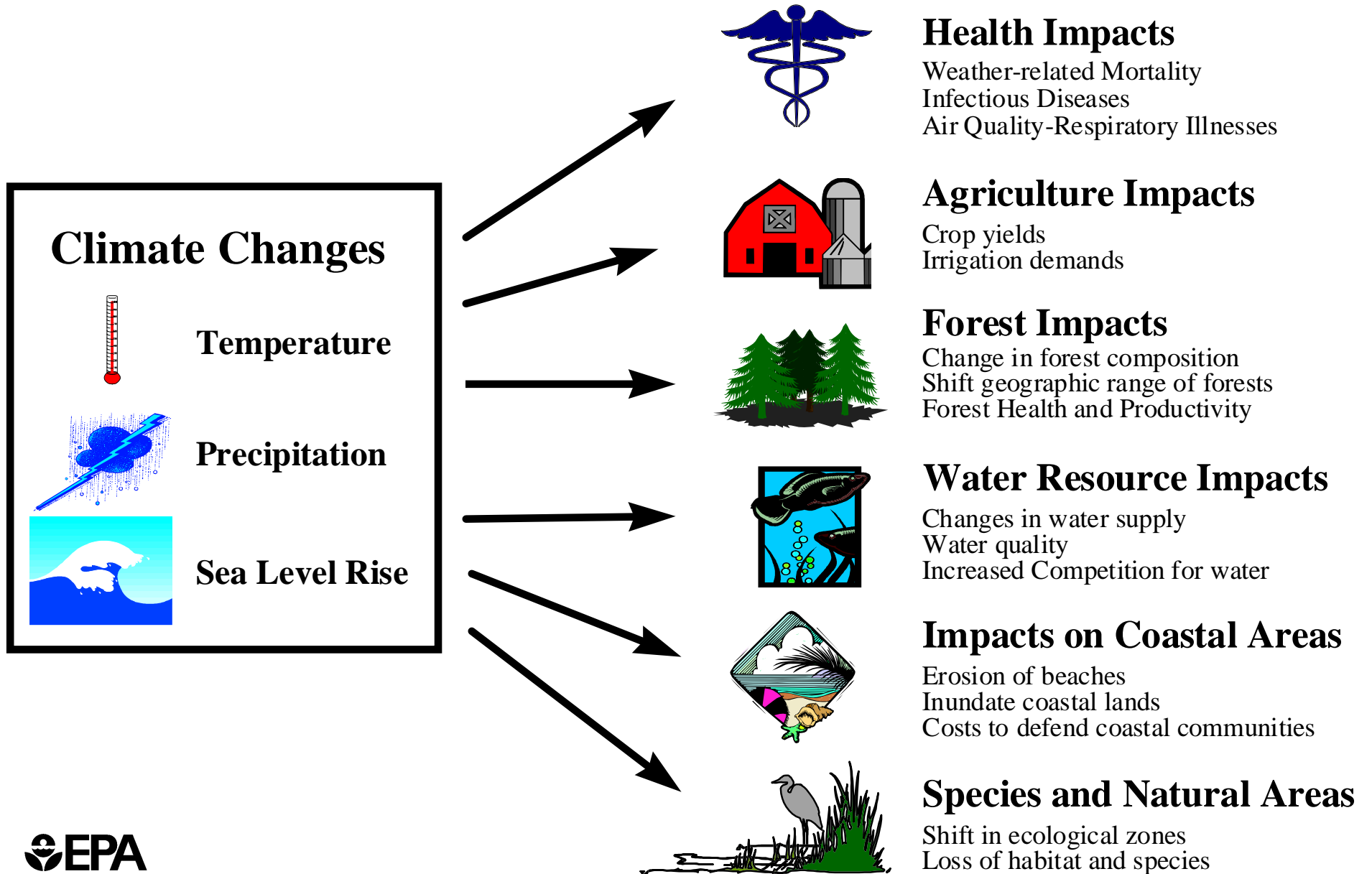


Climate Change Impacts

- Human health, natural ecological systems, and socioeconomic systems are all sensitive to both the magnitude and the rate of climate change
- Many physical and ecological systems will be simultaneously affected
- The ability of natural ecological systems to migrate appears to be much slower than the predicted rate of climate change
- **“With the growth in atmospheric concentrations of greenhouse gases, interference with the climate system will grow in magnitude, and the likelihood of adverse impacts from climate change that could be judged dangerous will become greater” (IPCC, 1995)**
- Climate change can add to existing environmental stresses

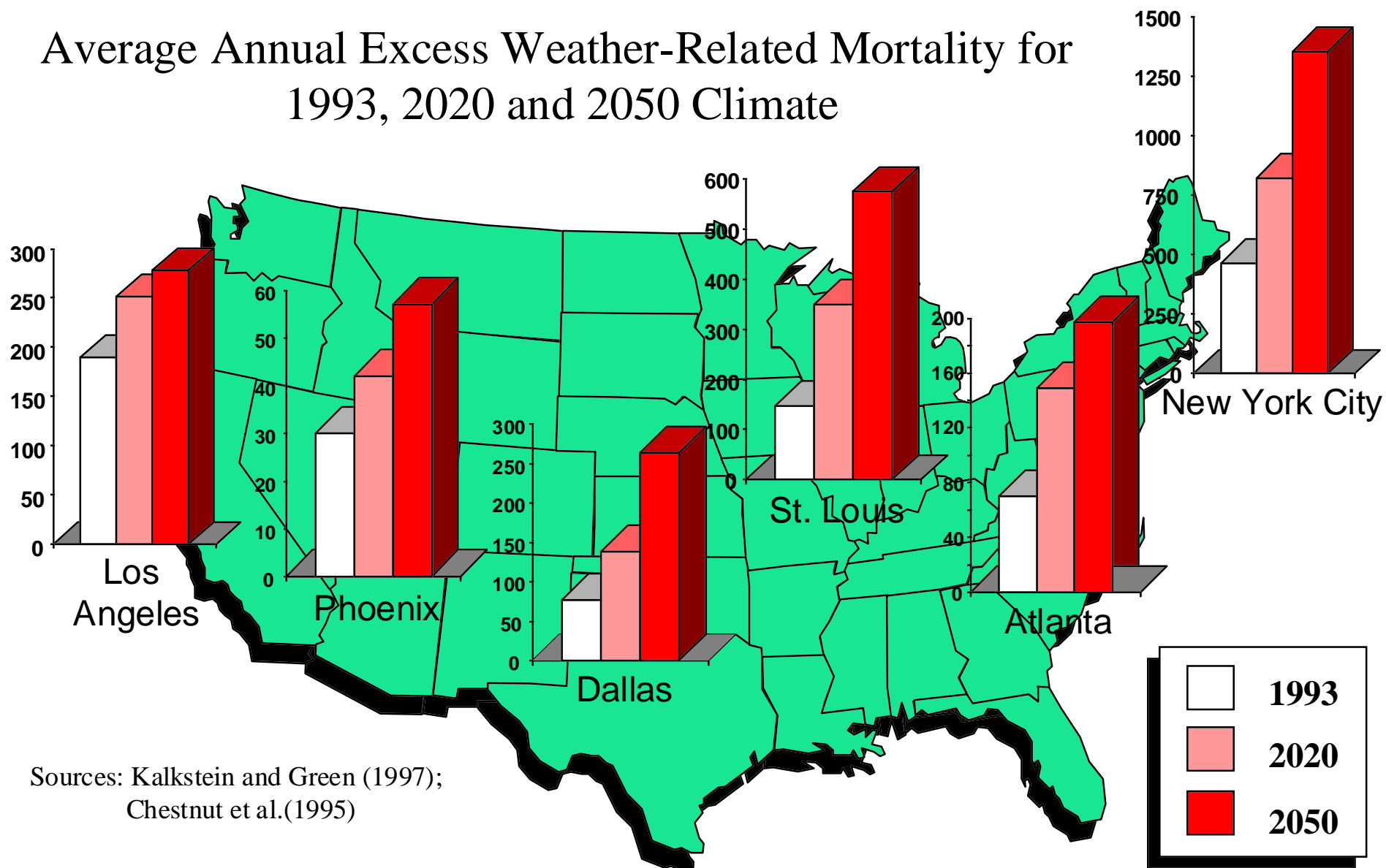
Potential Climate Change Impacts



Direct weather-related mortality

- Climate change is expected to increase the frequency of very hot days
 - For Chicago, if average July temperatures rise 5.4°F, the probability the heat index will exceed 120°F during the month increases from one in 20 to one in 4
- During heat waves, deaths from cardiovascular and respiratory illnesses also increase
- Winter mortality may decrease, but not expected to offset summer mortality increases
- The elderly, particularly those living alone, and children are in the greatest danger during heat waves

Average Annual Excess Weather-Related Mortality for 1993, 2020 and 2050 Climate



Sources: Kalkstein and Green (1997);
Chestnut et al.(1995)

Note: Includes both summer and winter mortality.
Assumes full acclimation to changed climate.
Includes population growth.

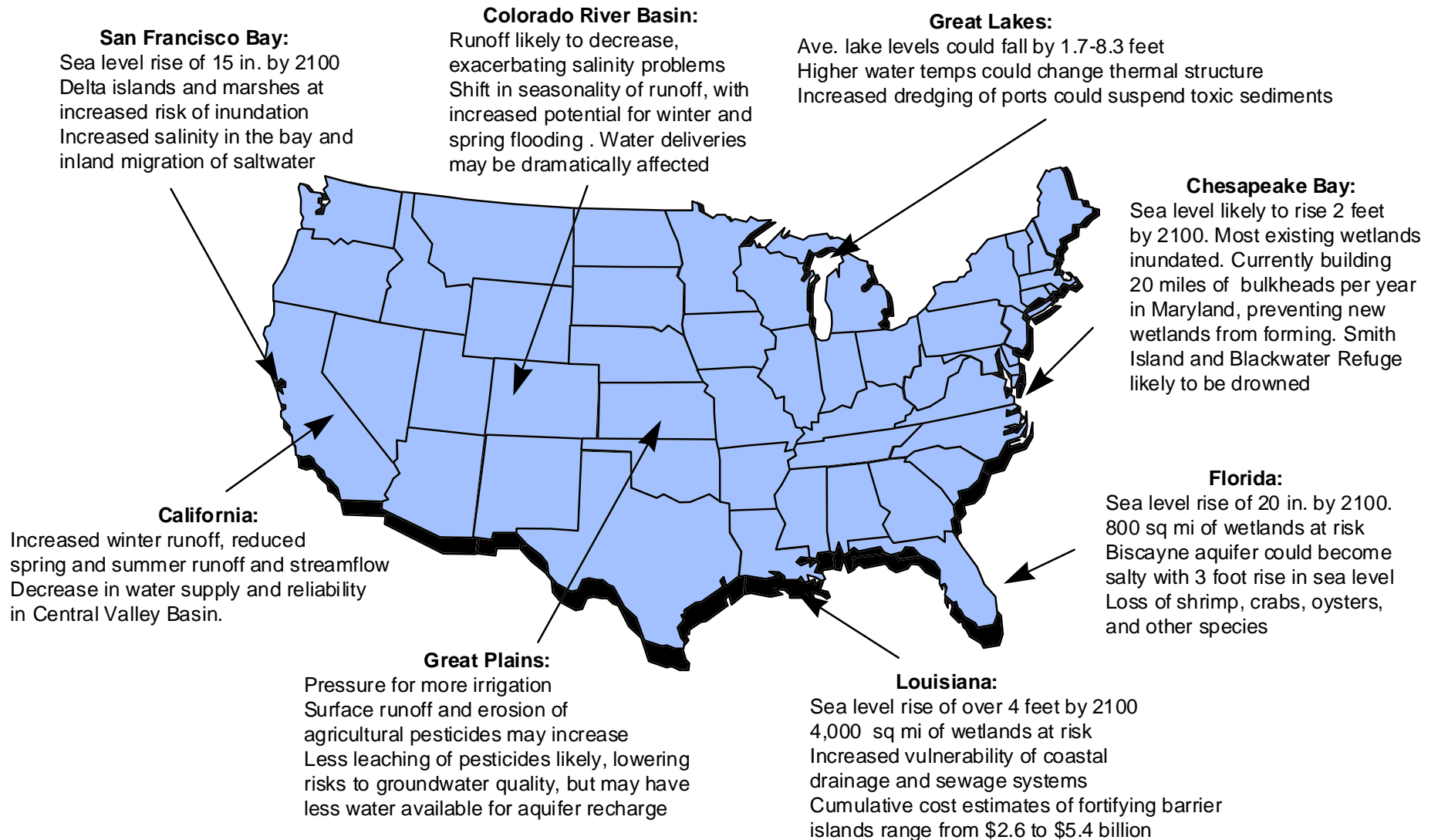
GFDL Climate Change Scenario



Water Resources

- Precipitation changes and increased evaporation can affect:
 - water supplies
 - water quality and drinking water
 - water uses: hydropower, irrigation, fisheries
- Floods more likely due to more intense rainfall
- Droughts likely to be more severe due to increased evaporation and drier soils
- Climate change will add to stresses in the Great Basin, California, Missouri, Arkansas, Texas Gulf, Rio Grande and Lower Colorado river basins

Examples of Regional Water Impacts



Source: EPA, 1989; EPA, 1995

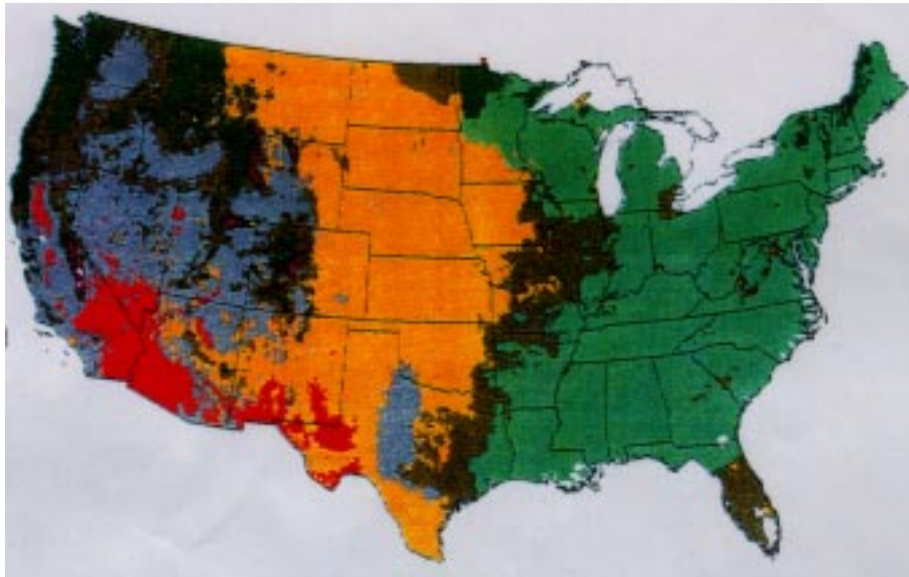


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Impacts on Forests

- Suitable habitats for many tree species likely to shift faster than rate at which trees naturally migrate
- Forest dieback due to drought, insects and disease may increase, especially along southern boundaries and in drier areas
- Projected increase in summer droughts would increase risk of forest fires, especially where forests are already under stress
- At risk are commercial timber production, recreational activities, and wildlife habitat

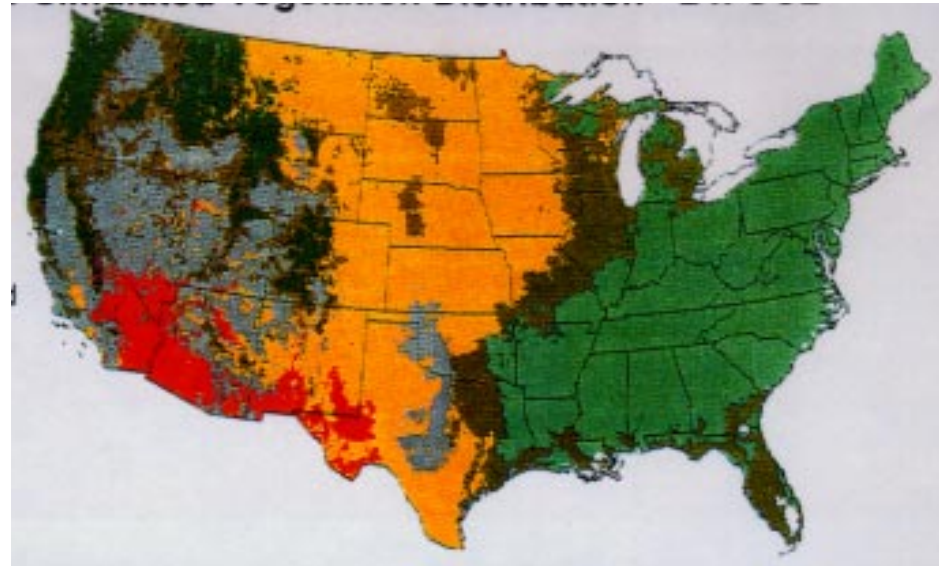
Change in Potential Vegetation for 2050 Climate Scenario



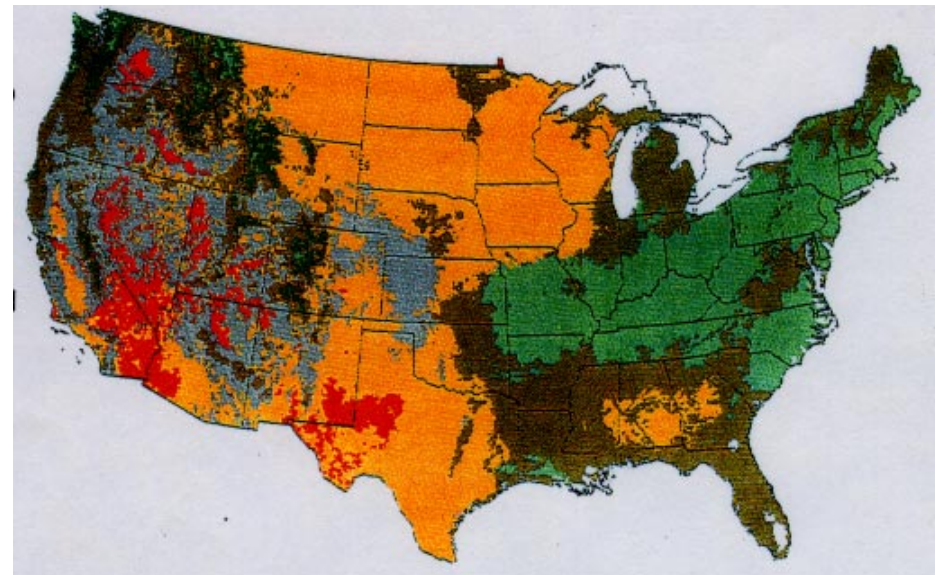
Current Climate



Source: Neilson, 1995



OSU Climate

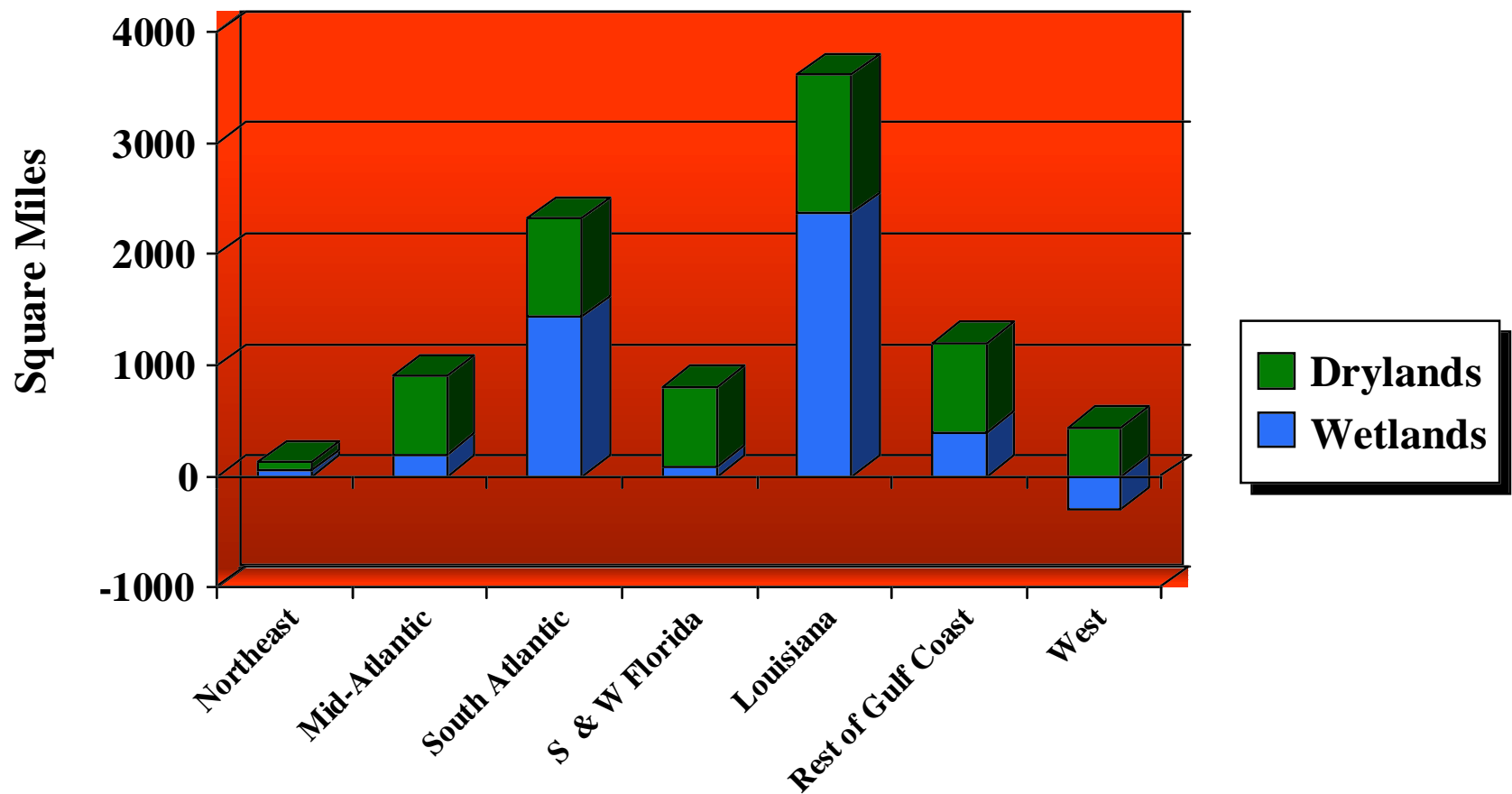


UKMO Climate

Impacts on Coastal Areas

- Along much of the U.S. coast, sea levels have risen 10-12 inches in the last century
- Sandy beaches would be eroded 100-150 feet with a 1-foot rise in sea level in 2100
- The projected global sea level rise of 20 inches (6-38 inches) by 2100 could:
 - Inundate 5,000 square miles of dryland
 - Drown 15-60 percent of our coastal wetlands
- Some states will experience greater increases in sea level (e.g., over 4 feet in Louisiana)
- Cumulative capital costs of defending against a 20 inch rise in sea level are estimated at \$30-40 billion (1988 \$)

U.S. Coastal Lands at Risk from a 20-inch Sea Level Rise in 2100



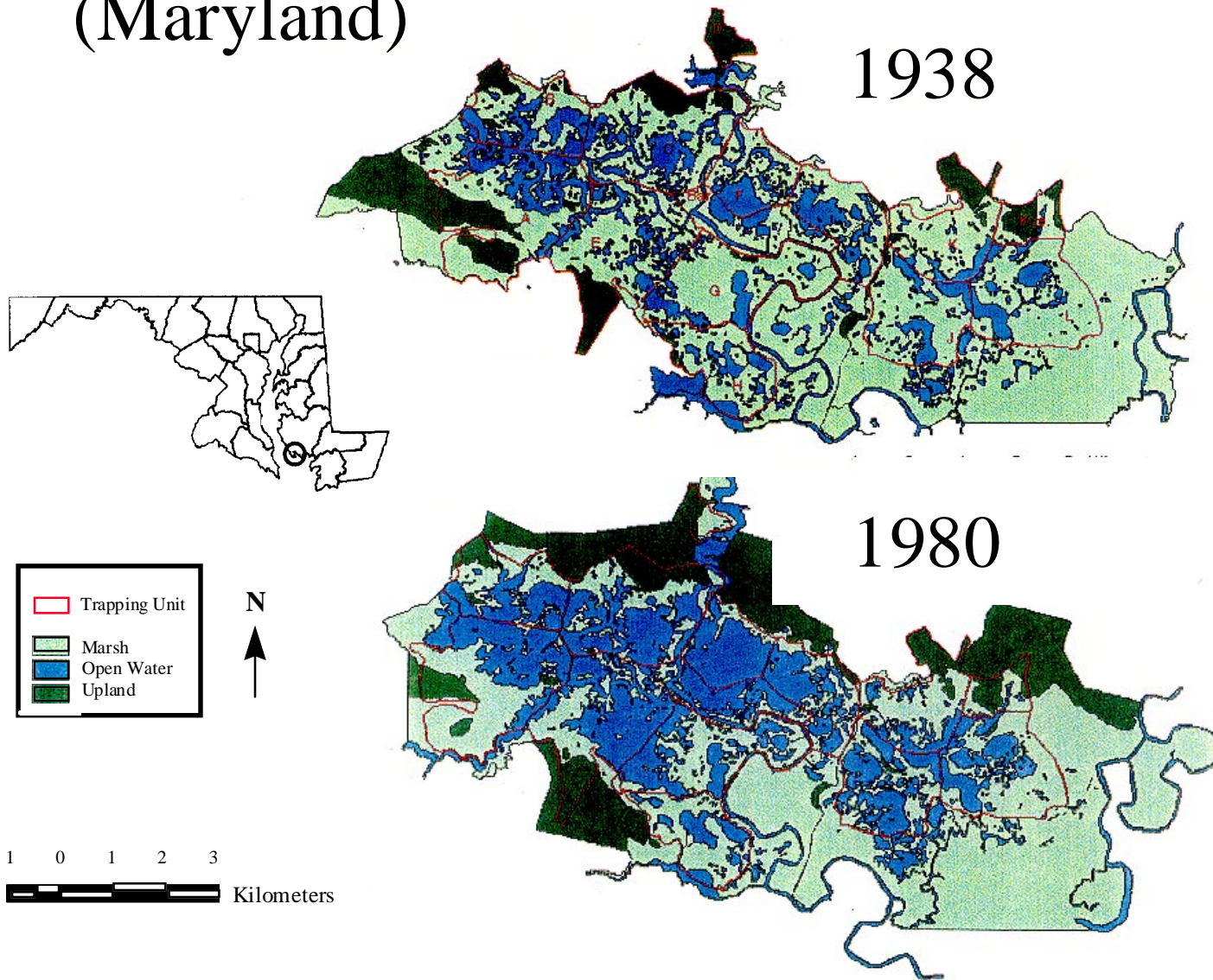
Source: U.S. EPA (1989).



Impacts on Wetlands

- Coastal wetlands are vulnerable to sea level rise and coastal erosion
 - At risk: fish, shellfish, flood and erosion control, habitat
- Inland freshwater marshes (including prairie potholes) are vulnerable to hotter, drier conditions
 - At risk: migratory bird and other species habitat
- Western riparian wetlands are vulnerable to hotter, drier conditions
 - At risk: fish and wildlife habitat, flood and erosion control, water quality, grazing

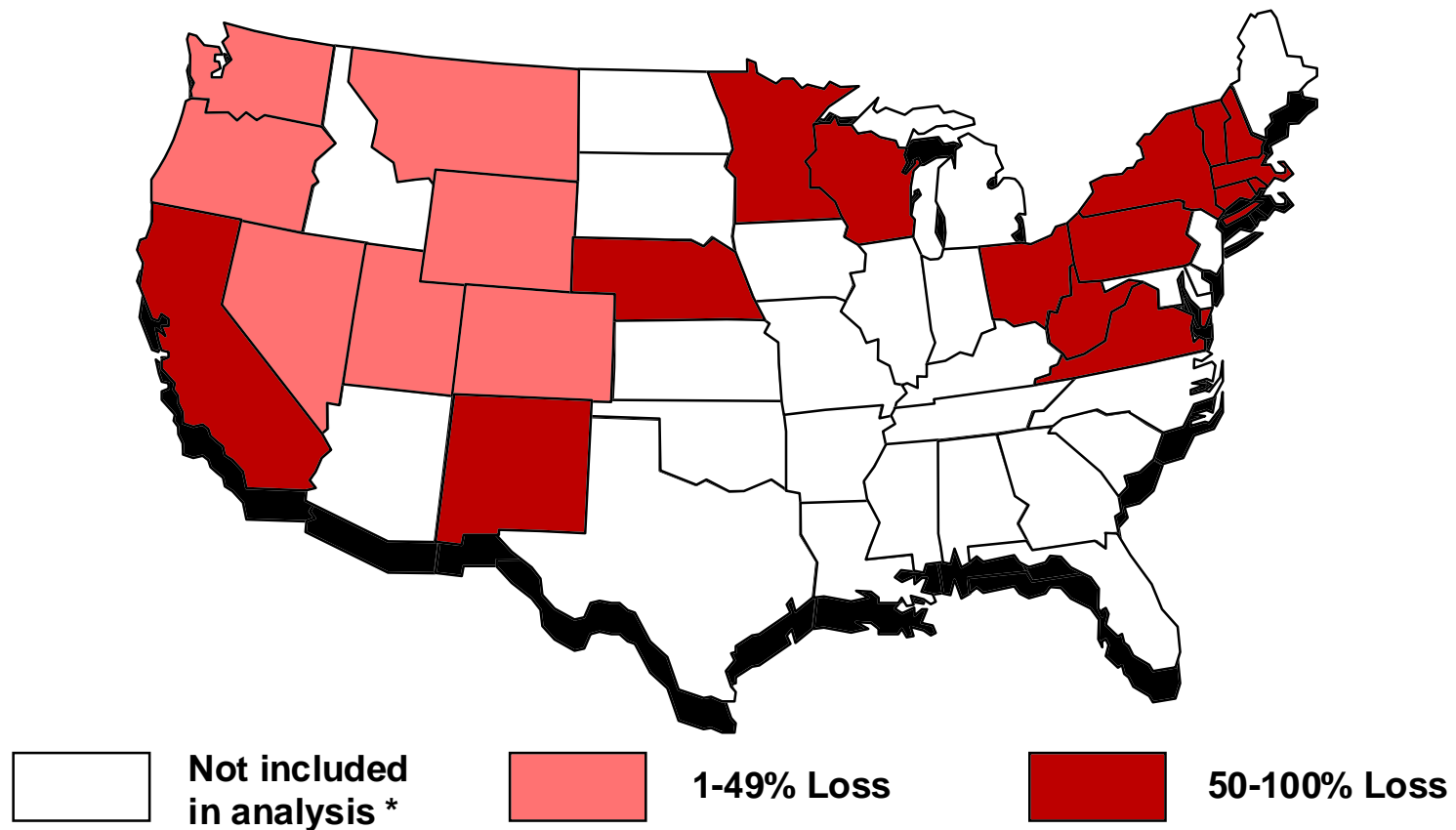
Blackwater National Wildlife Refuge (Maryland)



Impacts on Species

- Each 1°C of warming will shift temperature zones by about 100 miles northward (or 500 feet in elevation)
 - Many plant and animal species will be unable to migrate fast enough to find suitable habitats
 - Natural or man-made barriers may block natural migration
- Climate change poses risks to major U.S. national parks (*e.g.*, Everglades National Park, Glacier National Park)
- An increase of 3°C could threaten 7-11% of North America's plant species
- Northern limits of many birds strongly associated with climate
- Loss of cold-water fish habitat of 1.7-2.3 million acres by 2060

Loss of Habitat for Brown Trout from a Doubling of CO₂ - 2050



* Dual screening criteria used for inclusion: 1) Thermal modeling predicts suitability and 2) Fish presence in 10% or more of State's water bodies.

Source: EPA, 1995

GFDL Climate Change Scenario

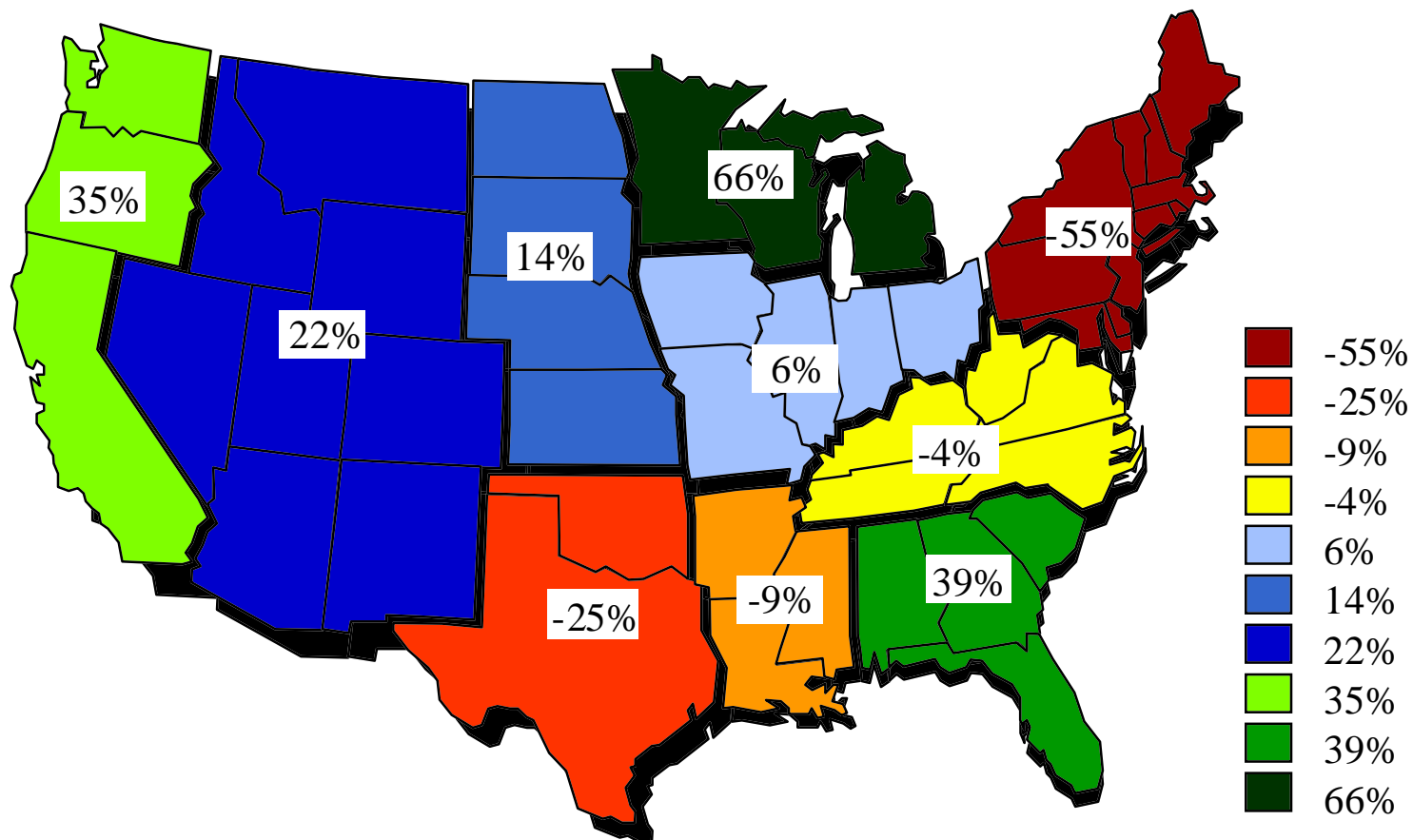


Agriculture

- Current modeling is inadequate because it fails to fully account for climate variability, adaptation, and indirect effects
 - Place specific modeling needed since temperature, precipitation, and soil moisture changes and water availability varies from place to place
- Average climatic changes projected to affect crop yields and the geographic distribution of crops
 - Some states will gain, but other states may see substantial losses
 - Some crops will be more impacted than other crops
- Farmers likely to adapt to changing climate conditions
 - Some agricultural adaptations may be costly
 - Adaptation may alter land-use patterns (e.g., forests converted into agricultural land)
 - Adaptation often depends on questionable availability of water

Change in Regional Crop Production - 2060

5°F Warming; 7% Increase in Precipitation; 530 ppmv CO₂



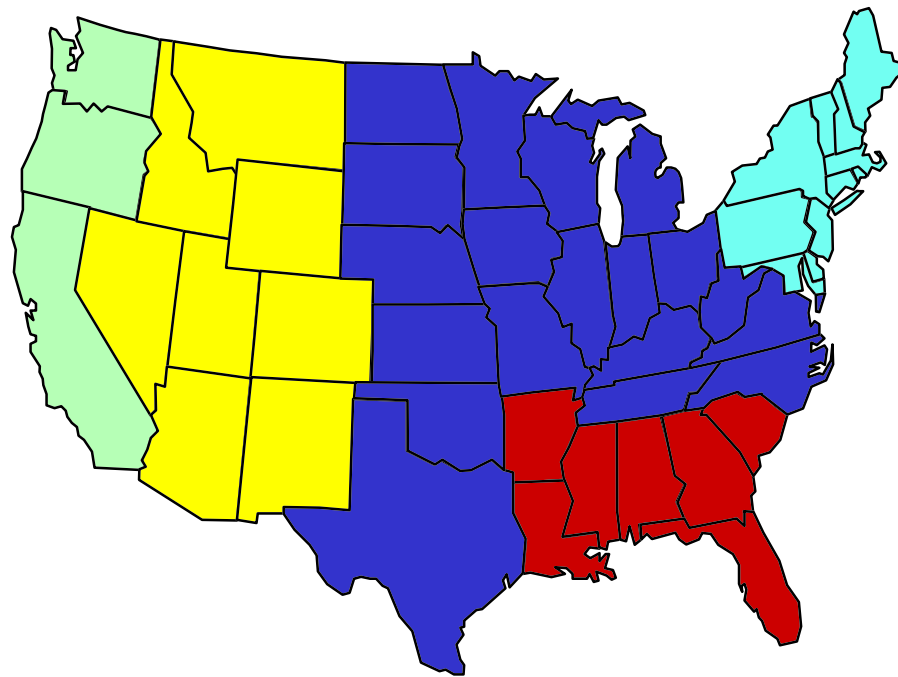
Source: Adams, et al. (1996)



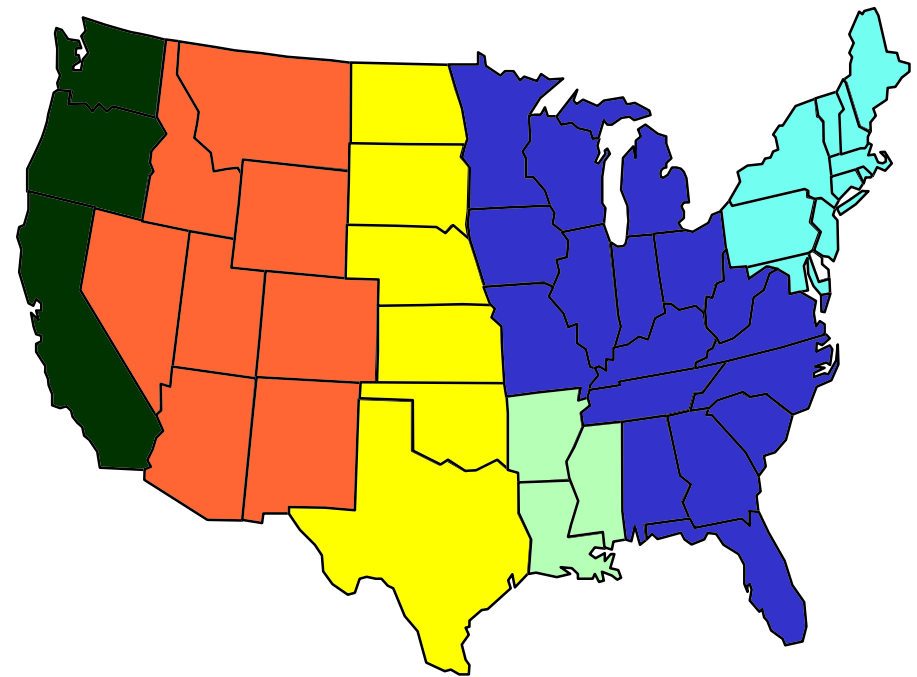
United States Environmental Protection Agency

Changes in Agricultural Yields

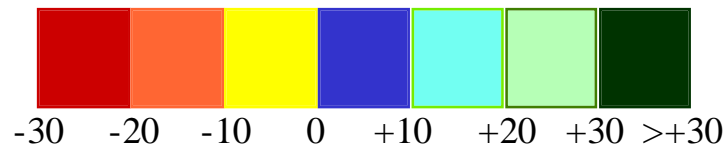
Change in Wheat Yield



Change in Corn Yield



Percent Change



+ 2.5°C
+ 7% Precipitation
530 ppmv CO₂

Source: Rosenzweig, 1995



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